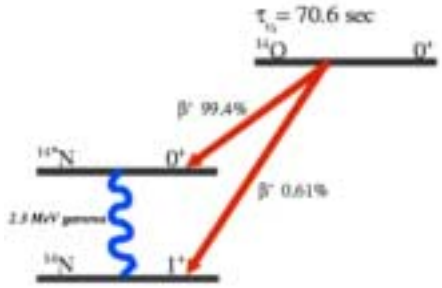
Testing the CVC Hypothesis in the Beta Decay of ^{14}O

J. T. Burke[1,2], S. Freedman[1,2], B. Fujikawa[2], P. Vetter[2], W.T. Winter[1,2], D. Wutte[2]

The Conserved Vector Current (CVC) hypothesis, of the electroweak theory, predicts a distortion of the allowed beta decay spectrum. CVC modifies the allowed spectrum by introducing an energy dependent shape factor ($a_{\pm}$) that is directly related to the width of the electromagnetic M1 transition in the isobaric analog state. CVC has been tested in the A = 12 (^{12}B, ^{12}C, ^{12}N) system. Several experiments have arrived varying conclusions. An experiment in the A = 14 (^{14}C, ^{14}N, ^{14}O) system is desirable due to the large shape factor predicted by CVC, a = 5.5 % per MeV. The experiment has been difficult to perform to high precision due to the small branching ratio to the $0^+ \rightarrow 1^+$ branch of approximately 0.6 percent, see decay scheme below [1].

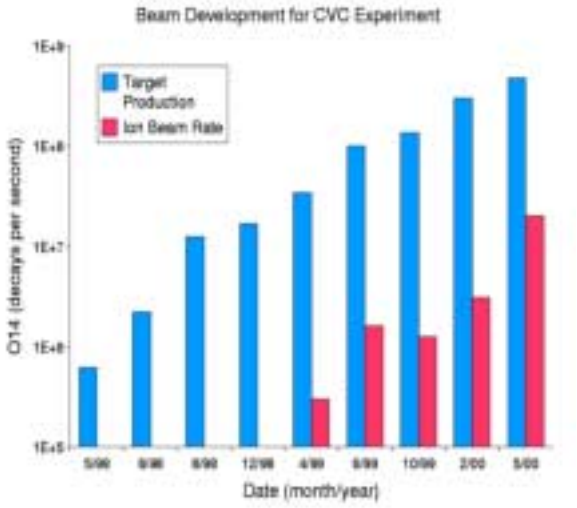


We will measure the shape factor using a flat−field magnetic spectrometer with a multi−wire proportional chamber detector. The acceptance of the spectrometer is on the order of 10^{-4}. In order to test the theory to the level of the theoretical calculations we require a point like source of ^{14}O of at least 10^7 atoms for several days. Due to the short, 70 second, half−life of ^{14}O it must be produced on−line at the 88" Cyclotron. The ^{14}O is produced by $^{12}C(^3He,n)^{14}O$ reaction.

The target consists of a low density carbon aerogel which is resistively heated to 2000 degrees Celsius. The ^{14}O bonds to ^{12}C in the target forming $^{12}C^{14}O$ molecule predominately.

The $^{12}C^{14}O$ diffuses from the target into a transfer line connected to the electron cyclotron resonance Ion Source for Radioactive ISotopes (IRIS ECR). The $^{12}C^{14}O$ is dissociated, ionized, and extracted at up to a 30 kV. The ion beam travels through an analyzing magnet and the ^{14}O isotope is focused and embedded into a thin beryllium foil, forming a fixed point like source for the experiment.

During 2000 we tested the new carbon aerogel target. The reduced diffusion time out of the target resulted in a factor of 10 increase in released activity. IRIS was fitted with a quartz liner and improved support gas injection system which improved the ionization efficiency of $^{12}C^{14}O$ by a factor of 4. IRIS can now produce a beam of $^{14}O^{1+}$ ions with an average intensity of $2x10^7$ atoms per second. The spectrometer is going through its final testing stages and should be ready for the CVC experiment by mid 2001.



Footnotes and References

1 Physics Department University of California Berkeley
2 Nuclear Science Division Lawrence Berkeley National Laboratory

1. G.S. Sidhu and J.B. Gerhardt, Phys. Rev. 148, 1024 (1966).